Loading from 4 Mines
Comparison of July 2015 to August 2015

Samples and flow measurements were collected from 4 mines (Mogul, Red and Bonita, Gold King, and American Tunnel) near Cement Creek upstream of Gladstone, Colorado on July 15, 2015 and August 22, 2015. The Gold King Mine release occurred on August 5, 2015. The loads of contaminants were calculated using flows and metal concentrations from each mine. This document presents and compares the metal concentrations, flows, and loads from the mines.

1. Concentrations and flows from the 4 mines are shown on Table 1.

    a. Metal concentrations varied from July to August, with some concentrations increasing and others decreasing. The degree of increase or decrease varied widely depending on metal and location.

    b. Flow from the Red and Bonita Mine decreased and flow from the Gold King Mine increased significantly from July to August.

2. Comparison of overall loading from the 4 mines in July 2015 and August 2015 (See Table 2) shows the following:

    a. The total flow from the 4 mines increased from 724 gallons per minute (gpm) to 1155 gpm.

    b. The dissolved metals load increased for all metals of interest. The load increase ranged from 69% (zinc) to 422% (copper).

    c. The total metals load increased for all metals of interest (aluminum, cadmium, copper, lead, manganese, and zinc). The load increase ranged from 35% (lead) to 465% (copper) from July 2015 to August 2015.

    d. The overall dissolved metals load increased by 1220 pounds per day (lb/d) and the overall total metals load of the same metals increased by 1400 lb/d.

    e. Note that large percent increases can be an indication of low loads prior to the release.

3. Comparison of flow and loading from each of the 4 mines from July to August shows the following:

    a. The loads from the Mogul, Red and Bonita and American Tunnel in August were similar to or less than the loads measured in June. (See Table 3)

    b. The flow at the Red and Bonita decreased between July and August, contributing to a decrease in load. (See Table 3)

    c. The percentage of the total and dissolved metals loads from Mogul, Red and Bonita, and American Tunnel was lower in August than July. (See Table 4)

4. Comparison of loading from the Gold King Mine before and after the release (see Table 5) shows the following:

    a. The Gold King Mine contributed over half of the aluminum and copper load before the

release, and the percentage increased after the release.

b. The Gold King Mine released a small amount of the dissolved lead and manganese load (0 to 9%) prior to the release and approximately 50% after the release.

TABLE 1
4 Mines Metal Concentrations and Flow
(Metal concentrations in micrograms per liter (µg/L)

	July 15, 2015				August 22, 2015			
	Mogul CC02D	**Red and Bonita CC03D**	**Gold King CC06**	**American Tunnel CC19**	**Mogul CC02D**	**Red and Bonita CC03D**	**Gold King CC06**	**American Tunnel CC19**
	7/15/2015	7/15/2015	7/15/2015	7/15/2015	8/22/2015	8/22/2015	8/22/2015	8/22/2015
Flow (cfs)	0.123	1.150	0.154	0.187	0.1696	0.928	1.228	0.248
Flow (gpm)	55.0	516.0	69.0	84.0	76.1	416	551	111
pH	3.32	6.02	2.64	5.59	3.4	5.62	3.23	5.35
DISSOLVED METALS CONCENTRATIONS								
Aluminum	1970	2030	43500	4150	3400	2200	32000	4600
Cadmium	27.8	20.6	104	1.86	56	21	82	1.8
Copper	19.6	23.8	8830	17.3	18	8.8	5900	7.3
Iron	14,000	80,600	119,000	148,000	24,000	80,000	130,000	130,000
Lead	110	1.55	1.81	1	220	9.9	38	3.1
Manganese	16,600	29,700	29,400	49,600	27,000	32,000	35,000	47,000
Zinc	20,800	15,100	30,700	23,000	29,000	12,000	25,000	17,000
TOTAL METALS CONCENTRATIONS								
Aluminum	2020	3890	43,100	4500	3400	4000	33,000	4300
Cadmium	31.3	19.7	106	1.66	54	22	84	1.7
Copper	19.7	30.8	8660	15.1	16	17	6300	4.2
Iron	16,100	79,700	113,000	138,000	25,000	85,000	140,000	130,000
Lead	124	73.3	2.03	2.07	220	60	41	5.2
Manganese	16,700	28,400	29,200	41,300	27,000	33,000	38,000	45,000
Zinc	19,400	13,100	28,600	18,900	28,000	12,000	26,000	16,000

TABLE 2 Overall Metals Load from 4 Mines (Mogul, Red and Bonita, Gold King, American Tunnel)				
	Sum of 4 Mines	**Sum of 4 Mines**	**Sum of 4 Mines**	**Sum of 4 Mines**
Flow	724 gpm	1155 gpm	431 gpm	60% increase
	7/15/2015 (pounds per day)	**8/22/2015 (pounds per day)**	**Increase from July to August (pounds per day)**	**Percent Increase July to August**
DISSOLVED METALS LOAD				
Aluminum	54.8	232	177	323%
Cadmium	0.25	0.701	0.454	183%
Copper	7.50	39.1	31.6	422%
Iron	761	1456	695	91%
Lead	0.13	0.506	0.380	301%
Manganese	274	479	205	75%
Zinc	163	275	112	69%
TOTAL METALS LOAD				
Aluminum	66.42	247	181	272%
Cadmium	0.24	0.718	0.475	196%
Copper	7.40	41.8	34.4	465%
Iron	741	1548	807	109%
Lead	0.58	0.779	0.202	35%
Manganese	257	501	244	95%
Zinc	143	279	136	95%

TABLE 3 July to August Flow and Load Increase from Each of 4 Mines (Mogul, Red and Bonita, Gold King, American Tunnel)					
Flow Increase (gallons per minute)	21.1	-99.5	482	27.1	431
	CC02D (pounds/day)	**CC03D (pounds/day)**	**CC06 (pounds/day)**	**CC19 (pounds/day)**	**Sum of 4 Mines (pounds/day)**
DISSOLVED METALS LOAD INCREASE (Negative indicates decrease)					
Aluminum	1.08	-1.58	176	1.95	177
Cadmium	0.019	-0.023	0.456	0.001	0.454
Copper	-0.002	-0.103	31.7	-0.008	31.6
Iron	7.93	-99.3	762	24.2	695
Lead	0.087	0.040	0.250	0.003	0.380
Manganese	9.03	-24.0	207	12.7	205
Zinc	5.90	-33.5	140	-0.515	112
TOTAL METALS LOAD INCREASE (Negative indicates decrease)					
Aluminum	1.04	-4.10	183	1.20	181
Cadmium	0.018	-0.012	0.468	0.001	0.475
Copper	-0.003	-0.106	34.5	-0.010	34.4
Iron	8.78	-68.7	833	34.3	807
Lead	0.082	-0.154	0.270	0.005	0.202
Manganese	9.22	-10.9	227	18.4	244
Zinc	6.57	-21.2	148	2.29	136

TABLE 4 Percent of Load from Each of 4 Mines – July and August 2015 (Mogul, Red and Bonita, Gold King, American Tunnel)								
	Percent of 4 Mines Load - July				Percent of 4 Mines Load - August			
	Mogul CC02D	Red and Bonita CC03D	Gold King CC06	American Tunnel CC19	Mogul CC02D	Red and Bonita CC03D	Gold King CC06	American Tunnel CC19
DISSOLVED METALS LOAD								
Aluminum	4%	23%	66%	8%	1%	5%	91%	3%
Cadmium	13%	52%	35%	1%	7%	15%	77%	0%
Copper	0%	2%	98%	0%	0%	0%	100%	0%
Iron	2%	66%	13%	20%	2%	27%	59%	12%
Lead	90%	8%	1%	1%	40%	10%	50%	1%
Manganese	6%	67%	9%	18%	5%	33%	48%	13%
Zinc	13%	57%	16%	14%	10%	22%	60%	8%
TOTAL METALS LOAD								
Aluminum	3%	36%	54%	7%	1%	8%	88%	2%
Cadmium	13%	50%	36%	1%	7%	15%	77%	0%
Copper	0%	3%	97%	0%	0%	0%	100%	0%
Iron	2%	67%	13%	19%	1%	27%	60%	11%
Lead	21%	79%	0%	0%	26%	38%	35%	1%
Manganese	6%	68%	9%	16%	5%	33%	50%	12%
Zinc	13%	57%	17%	13%	9%	22%	62%	8%

TABLE 5 Gold King Mine Loading – July and August 2015				
	Gold King Mine Load – July 15 (pounds/day)	**Gold King Mine Load – August 22 (pounds/day)**	**Gold King Mine as Percent of 4 Mines July**	**Gold King Mine as Percent of 4 Mines August**
DISSOLVED METALS LOAD				
Aluminum	36.0	212	66%	91%
Cadmium	0.09	0.543	35%	77%
Copper	7.32	39.04	98%	100%
Iron	99	860	13%	59%
Lead	0.00	0.251	1%	50%
Manganese	24.4	232	9%	48%
Zinc	25.4	165	16%	60%
TOTAL METALS LOAD				
Aluminum	35.7	218	54%	88%
Cadmium	0.09	0.556	36%	77%
Copper	7.17	41.7	97%	100%
Iron	93.6	926	13%	60%
Lead	0.00	0.271	0%	35%
Manganese	24.2	251	9%	50%
Zinc	23.7	172	17%	62%